Factors Affecting the Sustainability of Information Technology Applications in Health Care

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Biomedical informatics is a relatively new field; sustainability of information technology applications has not been studied in detail. We examined what factors contribute to sustainability in other fields (ecology, construction materials, business, primary health care, and environment and development). We describe some aspects of sustainability that can be applied to biomedical informatics: effectiveness, efficiency, financial viability, reproducibility, and portability.

Introduction

Sustainability is a well-known concept in established fields. In biomedical informatics, a relatively new field, major efforts are underway to develop and examine new approaches and methodologies for the application of information technology in health care. However, little information is available concerning whether these systems have a sustainable effect on patient care. The majority of published reports demonstrate the initial successful application of information systems, such as clinical information systems, provider-order entry systems, computerized decision support systems, or data mining systems. Most system evaluations are performed once and in settings that are atypical and unrepresentative, such as large, tertiary care settings that also have a teaching responsibility. There are few reports that evaluate the sustainability of systems in the same or in other, more typical institutions. There is also a lack of an evaluative framework that assesses the sustainability of systems in our field. We examined how other fields apply the concept and propose a characterization of sustainability for the biomedical informatics community.

Characterization of Sustainability

The United Nations World Commission on Environment and Development defines sustainability in general terms as "development, which meets the needs of present generations without compromising the ability of future generations to meet their own needs." This concept has been adapted in the context of program development to define the capacity of a project, a program or a set of actions to continue over time without major interruptions. When applied to health care, sustainability was defined as "the capacity of the health system to function effectively over time with minimum external input." Factors that were considered in the sustainability assessment of a primary health care immunization program included a) effectiveness, measured by a given level of output; b) efficiency of services to optimize available resource usage and leverage demand and supply; c) financial viability; and d) equity, i.e., availability of services to underserved, unreached, and vulnerable populations. The construction materials field has three general objectives to assess sustainability: a) minimize the consumption of matter and energy; b) maintain a reasonable degree of human satisfaction, by minimizing cost, ensuring human comfort and safety, and edifying the human spirit; and c) causing minimal negative environmental impact. In ecology, the primary goal is the reasonable distribution of resources on earth to adequately meet human needs. Sufficient resources must be maintained, invested, or transformed in order to meet the needs of future generations. The sustainability of business goals, sometimes called the "triple bottom line," is defined as increasing profits, improving the planet, and improving the lives of people.

The various dimensions of sustainability can be adapted to the application of information technology in health care. We are concerned with: a) effectiveness, measured by outcome variables such as mortality, morbidity, safety, or quality of medical decision-making; b) efficiency, including factors that affect resource allocation for developing and maintaining systems, user training, etc.; c) financial viability, including cost-effectiveness of applications and return-on-investment in the long term; d) reproducibility, such as integration and application in a variety of different settings; and e) portability, measured by ease of implementing and adapting concepts and approaches to other environments.

Discussion

A few information technology applications have achieved high levels of effectiveness, efficiency, or financial viability; however, researchers have shown less concern regarding reproducibility and portability issues. As the field matures and more health care institutions are using information systems for patient care, a more formal and detailed framework to assess the different aspects of sustainability is needed.